

**Willamette River Newberg Pool
Towed Water Sport Zone and
Wake Surfing and Water Skiing Zone
River Bank Erosion Documentation and Evaluation**

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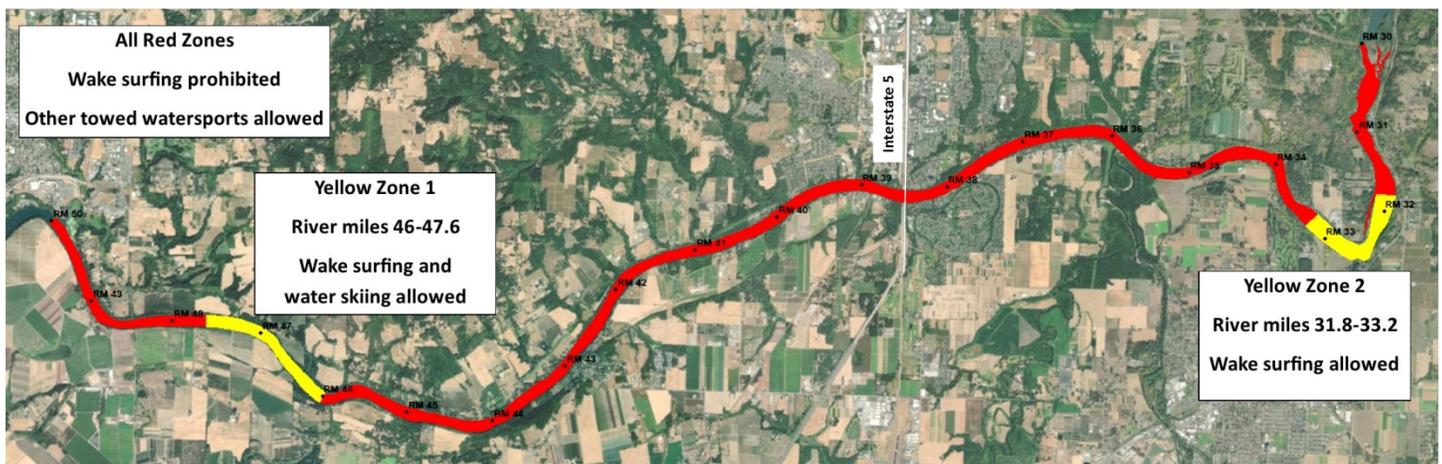
September 10, 2021

Willamette River Newberg Pool River Bank Erosion Documentation and Evaluation

Introduction

Ecological Engineering, LLC was contracted by the Oregon Recreational Boaters United to conduct an examination of river bank erosion and bank failure within the Willamette River Newberg Pool. Recreational boating on the Willamette River is regulated by the Oregon Marine Board. The Newberg Pool reach of the river covered by Marine Board regulations extends from River Mile (RM) 30 to RM 50. The regulated reach is further divided into two distinct zones: the Towed Water Sport Zone and the Wake Surfing and Water Skiing Zone. The Towed Water Sport Zone includes the entire reach from RM 30 to RM 50. There are two Wake Surfing and Water Skiing Zones within the larger Towed Water Sport Zone. Wake Surfing and Water Skiing Zone 1 extends from RM 46 to RM 47.6, and Zone 2 extends from RM 31.8 to RM 33.2. Wake Surfing and Water Skiing are only permitted within these two zones of the Newberg Pool. All other towed water sports are permitted in the entire regulated zone from RM 30 to RM 50. See the map below for a graphical depiction of the regulated zones.

Oregon Marine Board Towed Water Sport Regulated Zones Within the Willamette River Newberg Pool



During the 81st Oregon Legislative Assembly and the 2021 Regular Session, Senate Bill 857 was under consideration by the House Rules Committee. Senate Bill 857 **“Provides that maximum loading weight of motorboat must be less than 4,000 pounds to obtain towed watersports motorboat certificate. Authorizes State Marine Board to conduct study related to increasing prescribed maximum loading weight. Provides that person shall carry towed watersports endorsement if engaged in any towed watersports within Newberg Pool Congested Zone.”** The impetus for Senate Bill 857 is the belief that motorboats heavier than 4000 pounds are creating boat wakes (waves) that are causing significant river bank erosion, bank failures, and other harm to the river environment. Passage of Senate Bill 857 would place significant restrictions on recreational, and potentially commercial, activity and interests within a 20 mile reach of the river that is currently used by many recreational boaters. This reach of the river is used by both waterfront property owners and the general public from within the region.

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Despite the significant negative impact that Senate Bill 857 would have on boating activity within the Newberg Pool, no clear rationale or evidence has been presented to support it. The House Rules Committee held public hearings on the bill and arguments in favor and against the bill were presented without any substantial evidence provided to support those positions. The risk in passage of SB 857 without good supporting evidence is that it will create harm to the river users without solving the problem it intended to solve.

The Oregon Recreational Boaters United is a Political Action Committee that was formed to bring evidence to the table that would inform the discussion and provide more of a scientific and fact based process to future Oregon Marine Board rules changes for the Newberg Pool. Oregon Recreational Boaters United is composed of members whom spend a great deal of time on the Willamette River and have developed firsthand knowledge of conditions along this reach of the river and the factors that may influence those conditions. They believe that the application of science and knowledge can lead to improvements to the Willamette River and Newberg Pool for all users, adjacent property owners, fish, and wildlife. As a step in that direction, Oregon Recreational Boaters United contracted with Ecological Engineering, LLC to conduct an examination of river bank conditions within the Newberg Pool, both good and bad, and provide an engineering perspective on those conditions.

Approach

On August 17, 2021 David Gorman, PE of Ecological Engineering toured the Newberg Pool by motorboat from slightly above Surf Zone 1 at River Mile (RM) 48.5 near the Newberg Bridge to the lower boundary of Surf Zone 2 at RM 31.8, covering a distance of 16.7 river miles. Stops were made at 33 points of interest along this reach and a photo point was established at each. Photographs were taken at each point of interest along with coordinates of the location for georeferencing all photos and to map the location of each point of interest. Photographs were obtained of river bank conditions that included examples of bank erosion, scour, and mass failure and examples of stable banks and healthy riparian vegetation. Field notes were taken at each point of interest to assist in evaluating the photos in the office.

Mapping was created using Google Earth Pro and the coordinates obtained in the field to graphically locate all photo points on higher resolution aerial images. Due to the large area of coverage over 16.7 river miles, the mapping was divided into eight reaches of 2 miles in length with some overlap between each reach to avoid coverage gaps. Labels have been added to each reach to identify the location and number of photo points, the location of the upstream and downstream boundaries of Surf Zones 1 and 2, and approximate river mile markers.

A general sense of soil types and conditions of river banks within the study reach was obtained from the Natural Resource Conservation Service Web Survey. Hydrologic and hydraulic analysis was beyond the scope of this study and was not conducted.

All photos and associated commentary are presented in the following sections below by river reach.

Findings and Conclusions

Water levels in the Newberg Pool during the August 17th field work were typical for an August day and therefore typical for the occurrence of towed water sports, including wake surfing and water skiing. Water level is relevant because any erosion caused by boat wakes would appear on the bank above the water level. Conducting the field work at higher river levels would tend to obscure wake impacts.

River bank materials vary over the length of the towed water sports reach but are generally silt loams, silty clay loams, and fine sandy loams. All of these soils have some cohesive properties that tend to hold or bind them together, allowing the existence of some of the very steep river banks observed during the field work. The maximum stable slope of soils is known as their angle of repose. The angle of repose of granular material is the steepest angle relative to the horizontal plane at which a material can be piled without slumping or the surface sliding. It is related to material density, surface area, liquid content, shape of the particles, and the coefficient of friction of the material under consideration. Many materials, including loamy soils, experience a drastic reduction in the angle of repose when they are saturated compared with when they are unsaturated. When river banks are saturated, either due to higher river flows, precipitation, or the addition of water to the top of the slope, such as with irrigation, the water acts as a lubricant and decreases the inter-particle friction that helps to hold the soil in place. The addition of water from any source to the over-steepened river banks within this reach will increase the probability that the banks will undergo mass failure.

Instances of bank scour, mass failure of river banks, and potentially some boat wake erosion were noted during the field work and are presented individually by reach in the following section. Instances of stable river banks with healthy riparian vegetation have also been noted and presented below in separate river reach sections of this report. A quick summary of bank erosion and failure is provided below:

Table 1: Bank Erosion and Failure Instances Between RM 31.8 and RM 48.5 – Summary

Reach Number	Minor Bank Erosion Count	Major Bank Failure Count	Reach Within Surf Zone?
1	3	0	Yes
2	0	1	No
3	0	0	No
4	0	1	No
5	0	3	No
6	1	2	No
7	1	2	No
8	5	2	Yes
Total	10	11	
Instances per River Mile	0.60	0.66	

Over the 16.7 mile study reach, very few instances of bank erosion and bank failure were noted. In Table 1 above, “Minor Bank Erosion” was considered obvious bank soil loss without any significant threat to property.

Willamette River Newberg Pool River Bank Erosion Documentation and Evaluation

There were only about 10 instances of minor bank erosion over 16.7 miles of major river, for an average of 0.60 instances per mile. “Major Bank Failure” was considered significant soil loss, often to the top of the bank, with a clear threat to property. There were only about 11 instances of major bank failure over 16.7 miles of major river, for an average of 0.66 instances per mile.

River banks associated with an agricultural land use within the study area almost exclusively had stable banks with healthy riparian vegetation. The only minor exceptions were where the land owner lived close to the river and made some recreational use of it. Wherever there was frequent human access to the river, the riparian vegetation, which is critical to a stable river bank, was impacted. There is essentially no sign of bank erosion caused by boat wakes in the river reaches with a predominant land use of agriculture. This holds true in both the general Towed Water Sport Zone and the two Wake Surfing and Water Skiing Zone.

Nearly all of the erosion and bank failure observed was associated with intense residential development. Nearly all of the erosion and bank failure within residential areas was associated with modifications to the landscape and vegetation by the property owner. These modifications include, but may not be limited to, the following:

- Adding fill material riverward to expand or restore lot dimensions or to decrease lot slope
- Clearing vegetation from the riparian zone
- Allowing non-native and invasive vegetation to cover the river bank
- Planting ornamental vegetation within the riparian zone
- Dumping yard debris over the bank thereby decreasing native plant cover
- Construction of docks and associated structures
- Discharging stormwater runoff to the top of the river bank slope
- Over irrigating landscaping near the top of the river bank slope
- Failure to maintain leaking irrigation lines near the top of the river bank slope

There was little or no evidence to suggest that wakes from boats heavier than 4000 pounds, or any weight class, were causing bank erosion and failure. The preponderance of evidence suggests that individual residential property owners are manipulating the river banks and the property above them in a manner that is causing mass failures and bank erosion.

Willamette River Newberg Pool River Bank Erosion Documentation and Evaluation

There are some problems with bank erosion and failure within the Newberg Pool reach of the Willamette River. It is highly unlikely that the proposed legislation to restrict boat weight in this reach of the river will solve these problems. A more proactive solution would be to conduct additional study regarding the bank erosion and failures and use the lessons learned from that endeavor to develop an educational program for residential property owners within the reach. At a minimum, the program should develop a river bank owner's manual that teaches and promotes best practices for enhancing, stabilizing, and protecting river banks for the benefit of all river users, fish, and wildlife.



RENEWS: 6-30-23

Willamette River Reach 1

Willamette River RM 46-49

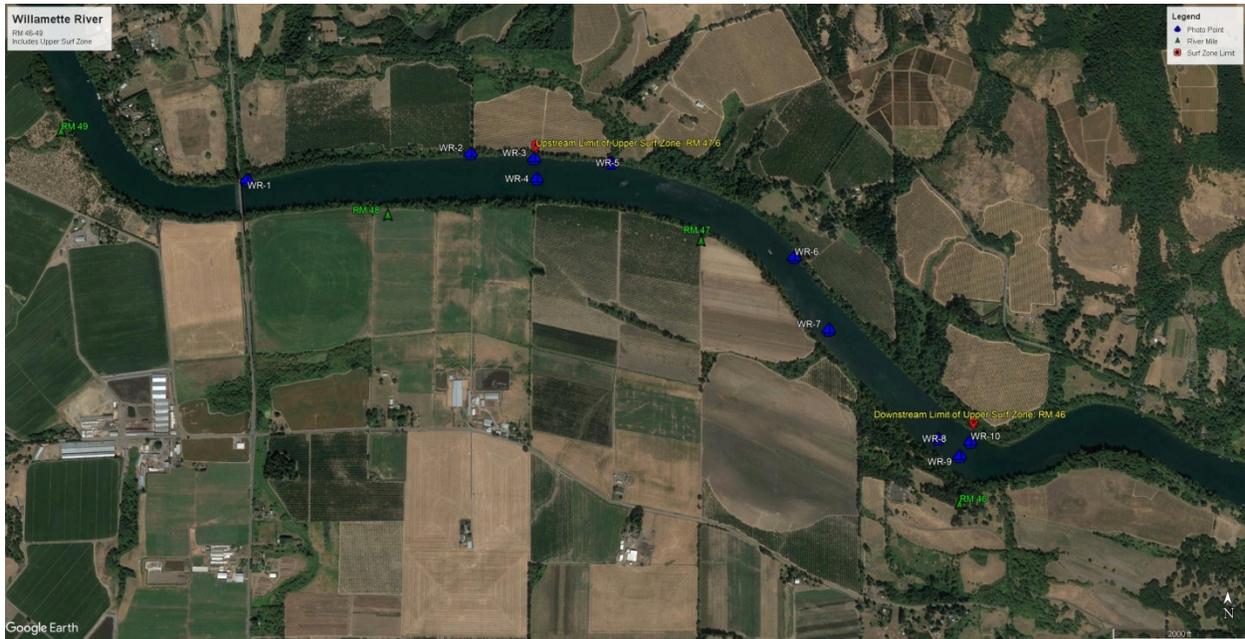


Photo WR-1A



Photos WR-1A through WR-1D were taken at Photo Point WR-1 (see map above) just downstream of the Newberg Bridge within the Oregon Marine Board designated Towed Water Sport Zone (Towed Zone) and approximately one river mile upstream of the upper limit of the Oregon Marine Board designated Wake Surfing and Water Skiing Zone #1 (Surf Zone 1). The river bank in this area was used as a reference for bank conditions inside of the Towed Zone but outside of Surf Zone 1.

There is a thick growth of willows (*Salix* sp.) along the lower and wetter portion of the bank with native trees higher up on the bank. There is no sign of bank erosion or failure.

Willamette River Reach 1

Willamette River RM 46-49

Photo WR-1B



Photo WR-1C



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-1D



Photo WR-2A



Photos WR-2A through WR-2C were taken at Photo Point WR-2 (see map above) just downstream of the Newberg Bridge within the Oregon Marine Board designated Towed Water Sport Zone (Towed Zone) and approximately 0.1 river mile upstream of the upper limit of the Oregon Marine Board designated Wake Surfing and Water Skiing Zone #1 (Surf Zone 1). The photos are of a boat dock and ramp within the Towed Zone but with no associated urban

development. The dock and ramp are on agricultural land with no housing nearby. The river bank has some areas with non-native invasive Himalayan blackberry (*Rubus ameniacus*) and some areas that have sparse vegetation, but there is little or no erosion or bank failure.

Willamette River Reach 1

Willamette River RM 46-49

Photo WR-2B



Photo WR-2C



Photo WR-3A



Photos WR-3A through WR-3D were taken at Photo Point WR-3 located at the upper end of Surf Zone 1 located at RM 47.6 (see map above and zone marking bouys in photos). These photos represent bank conditions at the upper end of the Surf Zone. The river bank is well vegetated with willow and native dogwood (*Cornus sericea*) lower on the bank with no sign of erosion or

Willamette River Reach 1

Willamette River RM 46-49

bank failure. The upper end of Surf Zone 1 is located in an agricultural area with no urban development of land uses.

Photo WR-3B



Photo WR-3C



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-3D



Photo WR-4A



Photo WR-4A was taken at Photo Point WR-4 located at the upper end of Surf Zone 1 located at RM 47.6 (see map above and zone marking buoys in photos). This photo represents bank conditions at the upper end of the Surf Zone. The river bank is well vegetated with willow and native dogwood (*Cornus sericea*) lower on the bank with no sign of erosion or bank failure. The upper end of Surf Zone 1 is located in an agricultural area with no urban

development of land uses.

Willamette River Reach 1

Willamette River RM 46-49

Photo WR-5A



Photos WR-5A and WR-5B were taken at Photo Point WR-5 (see map above) inside of Surf Zone 1 where land use is agricultural. The area is used recreationally by the nearby landowner with the house, barn, and other more intensive land uses a significant distance from the river bank. Impacts to riparian vegetation can be seen with some minor bank erosion where the vegetation is lacking. However, there is no significant bank erosion and no bank failures.

Photo WR-5B



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-6A



Photos WR-A through WR-6D were taken at Photo Point WR-6 (see map above) which is approximately in the middle of Surf Zone 1 in an area that is exclusively agricultural with no development or intensive landuses along the river banks. The river bank in this portion of Surf Zone 1 is very stable with good vegetation cover of native willows and dogwood. Due to its location within the central portion of the Surf Zone the river banks at WR-6

are subjected to the largest boat wakes generated from wake surfing and water skiing. Despite the intense wave activity in this area, there is no sign of erosion or bank failure.

Photo WR-6B



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-6C



Photo WR-6D



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-7A



Photos WR-7a through WR-7C were taken from Photo Point WR-7 in the lower one third of Surf Zone 1 (see map above). Land use in this portion of the Surf Zone is exclusively agricultural. The river bank has a minor amount of erosion in an area where willow and dogwood shrubs are lacking and vegetation is sparse. The predominant vegetation lower on the bank is non-native invasive Himalayan Blackberry. The cause of the erosion may be boat wakes

in the absence of other human activity, but there is no obvious cause.

Photo WR-7B



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-7C



Photo WR-8A



Photo WR-8A was taken at Photo Point WR-8 (see map above) at the lower end of Surf Zone 1 and adjacent to Champoeg State Park. Shortly before this photograph was taken a group of people were observed hiking and playing along this section of the bank. The bank erosion in this location is the result of frequent human access to the bank and land based recreation on the bank that has resulted in the elimination of the native riparian shrubs that are characteristic of

the bank both upstream and downstream of this location.

Willamette River Reach 1

Willamette River RM 46-49

Photo WR-9A



Photos WR-9A through WR-9C were taken at Photo Point WR-9 and Photo WR-10A was taken at Photo Point WR-10 (see map above). Both photo points are located at the lower boundary of Surf Zone 1 at RM 46. Land use on the right bank at this location is Champoeg State Park, and land use on the left bank is agricultural. Riparian vegetation is generally healthy on both banks but appears more dense on the left bank where the agricultural land use

likely has less of an impact than the right bank with the state park. No erosion or bank failures are evident in this location.

Photo WR-9B



Willamette River Reach 1

Willamette River RM 46-49

Photo WR-9C



Photo WR-10A



Willamette River Reach 2

Willamette River RM 44-46



Photo WR-11A



Photos WR-11A and WR-11B were taken at Photo Point 11 (see map above) approximately RM 45, 1 river mile downstream from the lower end of the Wake Surfing and Water Skiing Zone 1 (Surf Zone 1) and within the Towed Water Sport Zone (Towed Zone). These photos were taken of the left bank in an area where the land use is residential. All, or nearly all, of the river bank residential properties in this reach of the river have boat docks and ramps. At this location

the property owner has placed steel sheet pile with riprap behind it in an apparent attempt to stabilize the land behind the sheet pile. It appears that the bank has been excavated in this location based on the steep slope to the right of the sheet pile. The lack of vegetation and the presence an “alcove” or indentation in the bank may result in the formation of flow eddies at higher flows that will increase the erosional pressure on the steep bank.

Willamette River Reach 2

Willamette River RM 44-46

Photo WR-11B



Willamette River Reach 3

Willamette River RM 42-44



Reach 3 land use consists of a mix of agricultural, forest, and residential with residential comprising approximately two thirds of the reach. The reach is located within the Towed Water Sport Zone but not within the Wake Surfing and Water Skiing Zones 1 and 2. There are no Photo Points in Reach 3 because there were no notable incidences of bank erosion or bank failure.

Willamette River Reach 4

Willamette River RM 40-42



Photo WR-12A



Photo WR-12A was taken at Photo Point 12 (see map above). The photo shows a significant bank failure located on the left bank in an area where the land use is agricultural. A local citizen noted that a tree fell at this location during a recent ice storm. It is possible that bank scour or hydraulic failure followed that event during high winter flow events. Note that the boat wake zone is vegetated and relatively stable, indicating that boat wakes

were not the cause of this failure.

Willamette River Reach 5

Willamette River RM 38-40



Photo WR-13A



Photos WR-13A through WR-13C were taken at Photo Point 13 within the Towed Water Sport Zone but not within the Wake Surfing and Water Skiing Zone (see map above). The portion of the river bank in the photo has undergone a mass failure as a result of a combination of saturated soils from winter rains and high river water plus excess weight at the top of the slope from trees. The lower riparian vegetation appears healthy and

intact and there is no indication of slope undercutting resulting from waves. Photo WR-13C shows the presence of ivy on the slope. Ivy does not provide the same level of bank protection and stabilization as native willows and dogwood.

Willamette River Reach 5

Willamette River RM 38-40

Photo WR-13B



Photo WR-13C



Willamette River Reach 5

Willamette River RM 38-40

Photo WR-14A



Photo WR-14A was taken at Photo Point 14 very close to Photos WR-13A through WR-13C within the Towed Water Sport Zone but not within the Wake Surfing and Water Skiing Zone (see map above). This photo shows healthy riparian vegetation lower on the river bank and a ground cover of ivy on the upper bank. Bank stability could be improved by removal of the ivy and replacing it with native shrubs such as willow and dogwood.

Photo WR-15A



Photos WR-15A and WR-15-B were taken at Photo Point WR-15 within the Towed Water Sports Zone but not within the Wake Surfing and Water Skiing Zone (see map above). Conditions on the river bank suggest that the property owners have conducted either vegetation clearing and/or maintenance practices that prevent the growth of native riparian vegetation. There is healthy native riparian vegetation on the right side of the photo but

on the left side of the photo there is mostly only grass cover on the upper bank and Himalayan blackberry on the lower bank. The river bank appears to be stable but will be more susceptible to bank scour and boat wakes.

Willamette River Reach 5

Willamette River RM 38-40

Photo WR-15B



Photo WR-16A



Photos WR-16A and WR-16B were taken at Photo Point 16 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). There is some minor bank undercutting near the water level, but the soil loss at the base of the large tree appears to be the result of bank scour during high river flows. The larger recessed area to the right of the scour likely caused the formation of an eddy during high flows that resulted in the

scour. The lower bank is vegetated with Reed Canary Grass (*Phalaris arundinacea*) that has less bank stabilization ability than willows and dogwood. The scour has undermined the tree which will fall eventually due to high winds or additional scour from high river flows. When the tree does fall over it will exacerbate the erosion at this location.

Willamette River Reach 5

Willamette River RM 38-40

Photo WR-16B



Photo WR-34A



Photo WR-34A and WR-34B were taken from Photo Point 34 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). This mass failure was likely caused by a discharge of water at the top of the slope which adds weight to the soil and reduces the internal soil particle friction thereby reducing the slope's ability to support itself. This photo was taken on August 17, 2021 during a very dry time of year. However,

there is a wet soil down the center of the mass failure, indicating that there is a steady source of water being discharged to the top of the slope. At this time of year the source of the water is likely a broken irrigation line or over watering of the landscaping vegetation.

Willamette River Reach 5

Willamette River RM 38-40

Photo WR-34B



Photo WR-35A



Photos WR-35A through WR-35D was taken at Photo Point 35 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). These photos show a stabilized river bank that was professionally designed and permitted by the regulatory agencies with jurisdiction. The plantings of willow and dogwood are sparse and young but will be added to during the next planting season. Photo WR-35C shows what

vegetation will look like on the rest of the treatment once it has matured. The rock is more rounded than standard rip rap and has been placed with added aquatic habitat components. This type of bank stabilization is suitable for most of the river bank within the Towed Water Sport Zone.

Willamette River Reach 5

Willamette River RM 38-40

Photo WR-35B



Photo WR-35C



Willamette River Reach 5

Willamette River RM 38-40

Photo WR-35D



Willamette River Reach 6

Willamette River RM 36-38



Photo WR-17A



Photos WR-17A through WR-17E were taken at Photo Point 17 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). The top of the bank is precipitously steep in the vicinity of the white PVC piping. A possible cause of the mass failure is the saturation of the soil at the top of the bank from stormwater discharge onto the slope.

Discharging stormwater runoff from roofs and other impervious

surfaces adds weight to the soil and reduces the internal soil particle friction thereby reducing the slope's ability to support itself. Another contributing factor may have been bank scour during high river flows midway up the slope. The lower slope appears stable but is lacking significant native woody vegetation below the over steepened slope. This mass failure does not appear to be caused by boat wakes.

Willamette River Reach 6

Willamette River RM 36-38

Photo WR-17B



Photo WR-17C



Willamette River Reach 6

Willamette River RM 36-38

Photo WR-17D



Photo WR-17E



Willamette River Reach 6

Willamette River RM 36-38

Photo WR-18A



Photos WR-18A and WR-18B were taken at Photo Point WR-18 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). The lower part of the river bank is vegetated with mostly Reed Canary Grass (*Phalaris arundinacea*), some young trees, and Scouring Rush (*Equisetum arvense*) and shows no sign of boat wake erosion. The upper bank has undergone significant mass failure. There is a black

plastic pipe located in the approximate center of the bank failure. It is probably that prior to placement of the pipe there was a stormwater discharge to the top of the slope that may have contributed to the failure. The over-steepened river bank is prone to further erosion and mass failure during future wet seasons.

Photo WR-18B



Willamette River Reach 6

Willamette River RM 36-38

Photo WR-18C

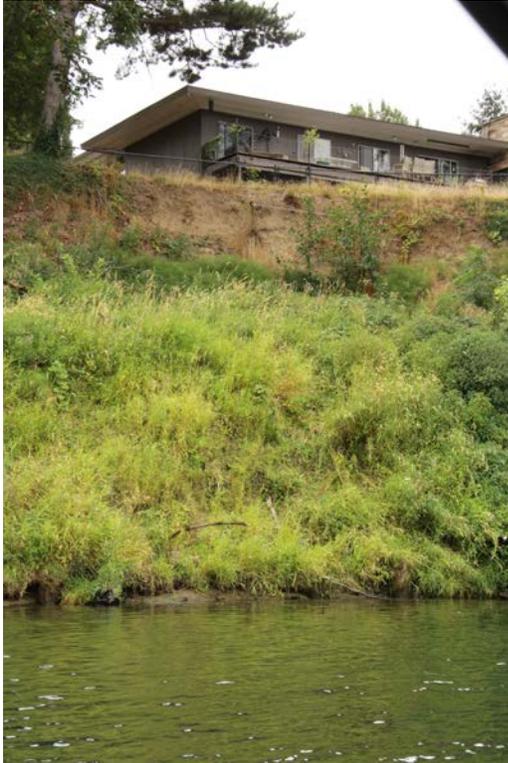


Photo WR-19A



Photo WR-19A through WR-19C were taken at Photo Site 19 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). The property owner(s) at this location are dumping yard debris down the river bank. The yard debris is acting as a mulch to prevent native woody vegetation from growing from the dump location, thereby increasing the probability that a high flow event will scour out the area under the debris and

may start an unraveling of the bank. Although there is some native woody vegetation along the bank in this area, much of the vegetation is Himalayan blackberry.

Willamette River Reach 6

Willamette River RM 36-38

Photo WR-19B



Photo WR-19C



Willamette River Reach 6

Willamette River RM 36-38

Photo WR-19D



Photo WR-20A



Photos WR-20A through WR-20D were taken at Photo Point 20 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). The bare soil all along the river bank and what appears to be a material haul road suggests that fill was recently added to the bank. The rip rap at the toe of the slope appears to have been dumped over the bank rather than carefully placed, and may actually lead to bank scour at higher river

flows. The bank is essentially devoid of vegetation and is highly prone to scour. Despite the loose soil and the lack of vegetation, there is not evidence of boat wake caused erosion.

Willamette River Reach 6

Willamette River RM 36-38

Photo WR-20B



Photo WR-20C



Willamette River Reach 6

Willamette River RM 36-38

Photo WR-20D



Photo WR-21A



Photos WR-21A and WR-21B were taken at Photo Point 21 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). The river bank on this property has some mass failure mostly hidden under the Himalayan blackberry canes toward the upper bank, but the lower bank has some healthy riparian woody vegetation that should be protective of the bank. This property was included here

because it is next door to the property described above and offers a contrast to its bank treatment.

Willamette River Reach 6

Willamette River RM 36-38

Photo WR-21B



Willamette River Reach 7

Willamette River RM 34-36

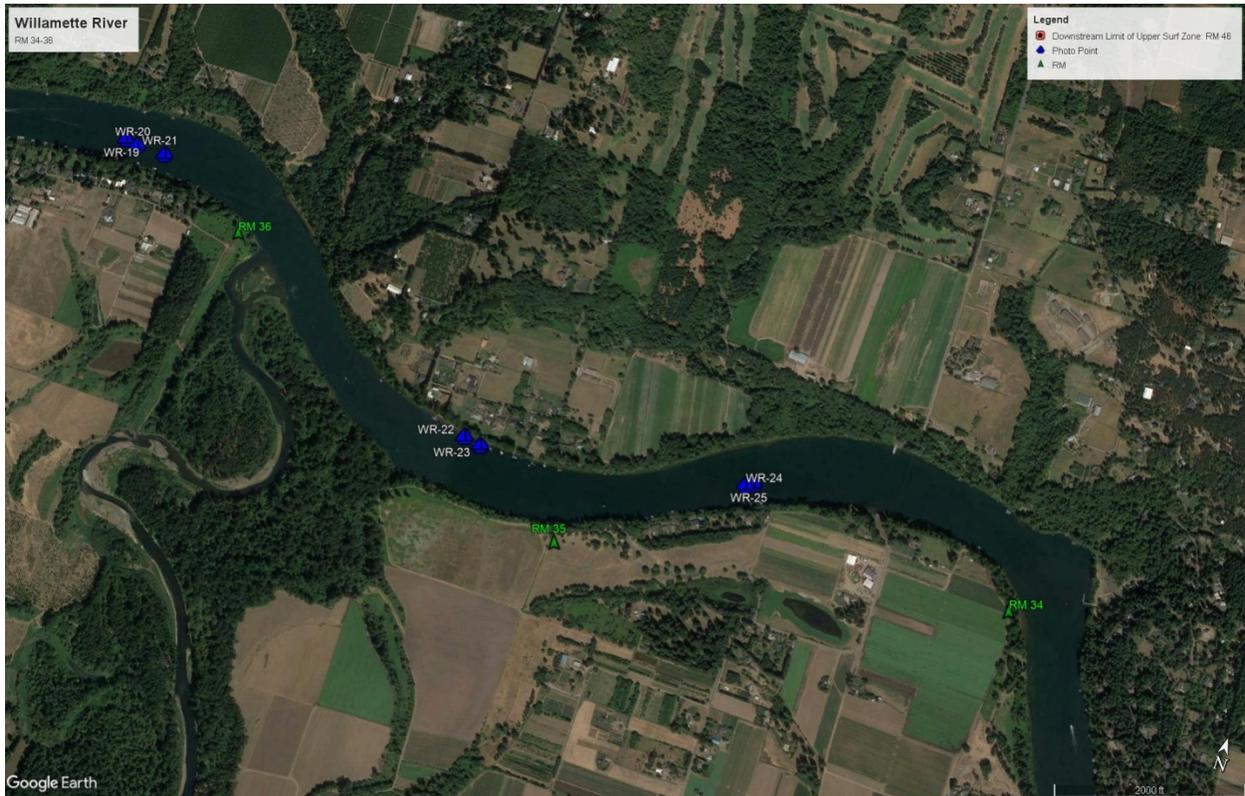


Photo WR-22A



the blackberry bushes and the dense planting of willow and dogwood.

Photos WR-22A through WR-22C were taken at Photo Site 22 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). Most of the river bank of this property is covered with Himalayan blackberry. Bank erosion can be seen underneath the blackberry bushes and above the boat wake zone. This is especially evident in Photo WR-22C. Long term stability of the bank will require removal of all of

Willamette River Reach 7

Willamette River RM 34-36

Photo WR-22B



Photo WR-22C



Willamette River Reach 7

Willamette River RM 34-36

Photo WR-23A



Photos WR-23A and WR-23B were taken at Photo Point 23 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). Much of this bank is covered with Himalayan blackberry with some willow on the lower portion of the slope. The blackberry makes the appearance of providing vegetative cover, but underneath the blackberry bushes is bare soil. The blackberry bushes prevent native vegetation from

growing and keep the soil mostly exposed to high river flows and potential scour.

Photo WR-23B



Willamette River Reach 7

Willamette River RM 34-36

Photo WR-24A



Photos WR-24A through WR-24D were taken at Photo Point 24 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). This mass failure appears to be the result of the discharge of water at the top of the slope. A white PVC pipe can be seen in the upper right hand corner of Photo WR-24B and is one source of water. Photos WR-24D and WR-24E show erosion rilling down the face of the slope from a

water source that is still discharging and keeping the bank soil moist. The toe of the slope is completely exposed bare soil and shows some signs of wave erosion. However, the greatest threat to the river bank is the discharge of water at the top of bank and the nearly complete lack of riparian vegetation. The placement of landscaping plants on the slope is not likely to protect the slope from bank scour in the short or long term.

Photo WR-24B



Willamette River Reach 7

Willamette River RM 34-36

Photo WR-24C



Photo WR-24D



Willamette River Reach 7

Willamette River RM 34-36

Photo WR-25A



Photos WR-25A through QWR-25D were taken at Photo Point 25 within the Towed Water Sport Zone but outside of the Wake Surfing and Water Skiing Zone (see map above). These photos are of the property just downstream of the property described above. They have been included here as a contrast to the river bank conditions shown in photos WR-24. The river bank on this property has dense riparian vegetation of willow and dogwood on the lower

half of the bank. There is no sign of bank scour, mass failure, or boat wake erosion.

Photo WR-25B



Willamette River Reach 7

Willamette River RM 34-36

Photo WR-25C



Photo WR-25D



Willamette River Reach 8

Willamette River RM 31-34



Photo WR-26A



Photos WR-26A through WR26C were taken at Photo Site 26 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). Photo site 26 is located at the upper end of the Surf Zone 2 at RM 33.2. Landuse on the left bank is agricultural and on the right bank is a combination of recreational (a golf course) and agricultural. Neither bank shows noticeable erosion or bank failure.

Willamette River Reach 8

Willamette River RM 31-34

Photo WR-26B



Photo WR-26C



Willamette River Reach 8

Willamette River RM 31-34

Photo WR-27A



Photos WR-27A through WR27C were taken at Photo Site 27 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). Photo site 27 is located at the upper end of the Surf Zone 2 at RM 33.2. Landuse on the left bank is agricultural and on the right bank is a combination of recreational (a golf course) and agricultural. Neither bank shows noticeable erosion or bank failure. There are some areas of the bank

that are lacking riparian vegetation due to land based human activity.

Photo WR-27B



Willamette River Reach 8

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Photo WR-27C



Photo WR-27D



Willamette River Reach 8

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Photo WR-28A



Photos WR-28A and WR-28B were taken at Photo Site 28 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). Landuse on the left bank adjacent to the photo site is intense agriculture with a significant amount of structures and activity. The river bank has been cleared of nearly all native riparian vegetation and there is evidence of frequent human activity on the bank. Some minor

bank erosion is present. It is possible that boat wakes contributed to the erosion, but no erosion is evident at the far left side of Photo WR-28A where riparian vegetation is still intact. The existing bank erosion would very likely not exist except for the vegetation removal.

Photo WR-28B



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Photo WR-29A



Photos WR-29A through WR-29D were taken at Photo Site 29 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). These photos show a combination of mass failure and bank scour. Potential contributing factors to the mass failure include the existence of a construction road at the top of the river bank and the associated placement of boulders at the top of bank. The added weight of the boulders and

construction vehicles plus the vibration of the traveling construction vehicles are likely contributors to the mass failure. Multiple dump trucks traveled this road to haul in sand to create an artificial beach for the unfinished resident at the end of the road. The bank scour may have been caused by boat wakes or higher river flows. Bank scour shown in Photo WR-29C appears to be caused by high river flows.

Photo WR-29B



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Photo WR-29C



Photo WR-29D



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Photo WR-30A



Photos WR-30A through Wr-30F were taken at Photo Point 30 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). This series of photos is of the right bank in the approximate center of Surf Zone 2 where the frequency and magnitude of boat wakes would be expected to be greatest. Land use adjacent to the bank is agriculture with little or no disturbance to the riparian vegetation. There is no evidence of

boat wake erosion, bank scour from high river flows, or mass failure. If boat wakes were the cause of bank erosion within the the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone it should be evident at this location, but it is not.

Photo WR-30B



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Photo WR-30C



Photo WR-30D



Willamette River Reach 8

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Photo WR-30E



Photo WR-30F



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Photo WR-31A



Photos WR-31A through WR-31I were taken at Photo Point 31 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). This series of photos is of the left bank in the vicinity a very large unfinished house. The access road to this house is the same as that discussed above for Photo Point 29. Bank erosion is evident in Photos WR-31A through WR-31 primarily where human activity has been the greatest and healthy

riparian vegetation is lacking. Most of the erosion is above the boat wake zone and is likely caused by high river flows against poorly vegetated banks.

Bank erosion shown in Photos WR-31F through WR-31H may have been caused by boat wakes. However, the bank erosion is only prevalent in those areas of the bank that have had the riparian vegetation removed. See Photos WR-30A through WR-30F taken across the river from Photo Point 31 for comparison with these photos.

Photo WR-31B



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Photo WR-31C



Photo WR-31D



Willamette River Reach 8

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Photo WR-31E



Photo WR-31F



Willamette River Reach 8

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Photo WR-31G



Photo WR-31H



Willamette River Reach 8

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Photo WR-31I



Photo WR-32A



Photos WR-32A through WR-32C were taken at Photo Point 32 within the Towed Water Sport Zone and within the Wake Surfing and Water Skiing Zone (see map above). This series of photos is of the relatively undisturbed right bank at the lower end of Surf Zone 2. Land use along the right bank is a mix of agricultural, residential, and industrial. None of these uses has caused significant disturbance to the riparian zone. The right bank is subjected to the same boat

wakes as the left but there is no evidence of erosion or bank failure from boat wakes, high flow bank scour, or mass wasting. The river bank looks healthy and stable.

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Photo WR-32B



Photo WR-32C



Photo WR-33A



Photos WR-33A and WR-33B were taken at Photo Point 33 at the lower boundary of Surf Zone 2 and represent the downstream extent of this survey.

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Photo WR-33B

